

# The Lepidoptera of Bahrain

BY

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(With three plates and one text-figure)

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## INTRODUCTION

Nothing has been published about the Lepidoptera of Bahrain before the present decade. Indeed, it would appear that no insect has been collected on the island before 1959, although its geology, as is natural in an oil-producing state, and its flora (see Good 1954) are better known.

### PHYSICAL FEATURES : ARTESIAN WATER-SUPPLY

The name Bahrain applies both to the principal island and to the archipelago. The lepidopterous fauna of the former is the subject of the present study. It is unlikely that the smaller islands contain any species not to be found also on the principal island, which far

exceeds all the others in area, elevation, variety of vegetation, and water supply. Its fauna, however, like that of most islands, though interesting, is restricted and poor.

Bahrain is situated at about Lat. 26° N., Long. 51° E., on the Arabian (south) side of the Persian Gulf, in a bay between the Eastern Province of Saudi Arabia and the peninsula of Qatar. The principal island measures about thirty miles from north to south and about ten miles from west to east at its widest point. The highest point, the Jebel Dokhan in the centre of the island, is only 400 feet above sea-level. The rainfall averages less than three inches annually; all of this falls in the cool season, between November and April. Most of the territory is arid desert but, thanks to artesian water, the northern part contains strips of oasis.

The artesian water-supply of Bahrain deserves further mention, as the island is quite unique in this respect, and the survival of a striking component of the fauna and flora depends on it. Among the Eocene strata of Arabia, sloping gently down to the sump of the Persian Gulf, is a brown crystalline Nummulitic limestone. Rain penetrates this limestone stratum where it outcrops in the high Arabian plateau, mainly in the Dahana. This underground water, owing to impervious strata above and below it, and to a peculiar local undulation, becomes concentrated under pressure over a narrow band, not wider than ten miles from north to south, flowing south-eastwards under the Arabian coast and the north end of Bahrain. The aquiferous stratum then surfaces in the sea-bed between Bahrain and Qatar, and much of the water is lost in the form of freshwater springs at sea, on either side of the north end of the island. In the centre of the island is a dome of Eocene strata; here the same brown limestone, itself capped by resistant chert, is uppermost in Bahrain's principal hill, Jebel Dokhan. Naturally the water-head is incapable of rising to this height but, from the dawn of the Holocene, fresh springs have gushed up in the flatter, northern parts of the island. In one place a stream, several miles long, reaches the sea in a wide estuary, and is probably the only stream in the whole of Arabia to do so on a perennial basis. The estuary shores are overgrown with mangrove bushes (*Avicennia*). Recently many wells have been bored into the aquifer both in northern Bahrain and on the mainland of the Eastern Province of Saudi Arabia. Due to these wells' excessive take-off reducing the underground pressure, the water-head is sinking annually, and saltwater is entering the aquifer at the eastern end. Though much lower than in early days, the water-head is nevertheless still above sea-level in Bahrain. The ancient Arabian oases of Qatif

and Hofuf correspond, on the mainland, to such Bahrain sources as Adari and Kasari.

Thanks to these amenities Bahrain was inhabited in Sumerian times by civilised man and was a prosperous trading entrepôt between the two civilisations of the Sind Valley and Mesopotamia. Over a hundred thousand funeral mounds line the dry slopes on either side of formerly, or still, cultivated land; well-carved stone temples and houses have recently been found in the excavation of the principal city and the numerous settlements of what the Sumerians called Dilmun. The date-palm seems to have been then, as now, the principal cultivated crop.

#### SUPPOSED EMERGENCE FROM SEA : FAUNISTIC EVIDENCE

As regards rather earlier times, geologists seem to agree that both Bahrain and the adjacent coasts of Arabia have been, and still are, rising gradually from the sea; there is archaeological evidence that in Sumerian times the sea-level was a few feet higher than now, but some geologists go so far as to say that the whole island was formerly submerged and at the best represented by a sea-washed reef. There is certainly a good deal of salt in its soil.

The present vertebrate fauna of the island however could scarcely have inhabited it when it was a mere reef. The presence of gazelle, and even hare, may be due to importation or reimportation by man, but could the same be said of the lizard (*Uromastix*) (Arab. *dhubb*) or the jerboas (*Meriones*)? Their presence suggests that Bahrain was formerly united to the mainland and has never been entirely submerged, to the detriment of its desert fauna, since that union.

Lepidoptera, being capable of flight, shed little light on this problem. No apterous species has been found on the island; but this may not be significant as it is not known whether any apterous species inhabits the adjacent mainland. At Kuwait and Bushire, indeed, two or three species with apterous females (*Chondrostega* and *Ocnogyne*) fly commonly, and their larvae swarm in spring, but they have not yet been noted in the Dhahran-Qatif district, close to Bahrain. It may be that these moths do not reach so far south on account of general ecological conditions unfavourable to them, whether on Bahrain or the mainland.

Good (op. cit.) noted the absence of endemic elements in the desert flora, and it seems unlikely that there are genuinely endemic lepidoptera in Bahrain. Exploration will probably eventually reveal

that the one or two species, which are now known only from the island (e.g. *Cryphia polyphaenoides* Wilts.) inhabit similar habitats in SE. Arabia. It must be remembered that until recently no entomological exploration at all took place in Bahrain, and that conditions in the rest of Arabia are still unfavourable to collection. If however the island's fauna proves to contain one or two true endemics, the theory that Bahrain was once a mere reef in the sea will evidently have to be abandoned and, instead, only a slight reduction in area, due to a slightly higher sea-level, could be accepted in the history of Bahrain. Even if there are no true endemics, the argument of the vertebrate fauna requires to be weighed, when considering the history.

#### BIOTOPES : VEGETATION

Before analysing the elements of the fauna, the biotopes and vegetation should be described. As elsewhere in the arid Middle East, there is a sharp contrast between the oasis and the desert. Each of these main two biotopes has a characteristic flora and fauna. In the list which follows, the less characteristic and also the entomologically uninteresting kinds of plant will be omitted.

##### (a) Oasis

One might well omit the mangrove swamp as being a maritime community. It appears devoid of Lepidoptera except that its fringe is possibly the home of *Cardèpia sociabilis*. Except for this swamp, the oasis vegetation is structurally entirely a flora of cultivation. The oasis vegetation is decidedly more tropical than that of the Mesopotamian oasis, even at its southernmost point (studied in Wiltshire 1950). The species absent from S. Iraq in the list below are marked (T). The absence of *Salix* and *Populus* is remarkable, and even *Tamarix* is rare.

Characteristic trees, probably indigenous, are:

Date-palm (*Phoenix dactylifera*) (Arab. *Nakhl*)

Christ-thorn (*Zizyphus spina-christi*) (Arab. *Tebek, Sadr*)

Deciduous mesquite (*Prosopis stephaniana*) (Arab. *Shoq*).

The third of these, though often no more than a shrub, attains a height of 5 metres in some gardens, but is rather more localised than the others.

Other commonly planted trees, probably more recently imported, are:

(T) Evergreen mesquite (*Prosopis spicigera*)

(T) Indian almond (*Terminalia catappa*)

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Scene in southern desert

Limestone hills with sand, and pipe-line from oil-well. Vegetation seen is mainly *Leptadenia pyrotechnica* and grasses. Flying place of *Anumeta straminea* etc.



*Taverniera spartea* in flower

On northern flanks of desert near Ali. Foodplant of *Drasteria yerburyi* etc.

Photos : E. P. Wiltshire

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The Kasari washermen's pool

One of the natural sources of Bahrain. On left dense oasis vegetation; right bank converted to dhobi-ghat in Indian style. Flying place of *Mocis frugalis* etc.



Rocky desert hills in southern desert

Showing *Lycium persicum* and *Ochrodenus baccatus* in flower. Locality for *Jordanisca tenuisaria* and *Neromia pulvereisparsa*

Photos : E. P. Wiltshire

(T) Mango (*Mangifera indica*)

(T) Flamboyant (*Delonix regia*)

(T) Tamarind (*Tamarindus indica*)

Casuarina (*Casuarina equisetifolia*)

Tamarisk (*Tamarix articulata*) (Arab. *Ithl*).

Lawn-grass (identity uncertain) is entomologically most important.

Garden ornamental shrubs include:

Oleander (*Nerium oleander*) (first imported within living memory)

Jasmine (*Jasminum* sp.).

Citrus trees, recently introduced, do not thrive on Bahrain soil; their presence is welcome to the lepidopterist for the sake of the handsome butterfly *Papilio demoleus* L. The more serious pests of the tree have also, to some extent, arrived in the island.

Commonly planted as a hedge, and perhaps indigenous, is:

(T) *Clerodendron inerme*.

Common oasis plants, doubtless indigenous, are:

Camel-thorn (*Alhagi maurorum*)

Reed (*Phragmites communis*)

Caper (*Capparis spinosa*).

The third of these is more local, but seems to be spreading.

Probably indigenous is the very local shrub:

*Pluchea dioscorides*.

A dwarf shrub common in oasis and desert alike and almost ubiquitous is:

*Zygophyllum album*.

The most thriving ground crop in oases is Lucerne or Alfalfa (*Medicago sativa*). Tomato (*Solanum lycopersicum*) and Lettuce (*Lactuca sativa*), with a briefer season, are also grown.

#### (b) Desert

As Good (op. cit.) pointed out, the desert-flora is a widespread Saharan-Sindian type, with many absentees. Here again the less noteworthy and entomologically uninteresting are omitted. Two species of tree are noteworthy but both are very local:

*Leptadenia pyrotechnica* (only in the southern desert)

*Acacia arabica* (only at Sakhir, in an alluvial desert-valley).

Localised desert plants of entomological importance are:

Pink desert-broom (*Taverniera spartea*) (Only on alluvial ground on the north and east 'flanks', between Sitra and Ali, where it forms conspicuous bluish green perennial stands; the ground appears here to have been formerly cultivated and even now to have a high

water content, as many of the herbs remain green throughout the summer)

*Pennisetum dichotomum* and other dune grasses (Only in the southern desert, where blown sand is found close to limestone cliffs. This habitat recalls closely a similar one near the Great Pyramid at Giza, near Cairo, and several characteristic moths inhabit both: e.g. *Scotia sardzeana* Brandt, *Anumeta straminea* B.-H. In summer the vegetation of this habitat appears quite dried up.)

*Helianthemum lippii* and *H. kahiricum* (common and more widespread than the grasses in the rocky and sandy desert south of Awali)

*Ochrodenus baccatus* (only on rocky hills, in the southern desert)

*Calligonum comosum* (only in the southern desert).

Rather more widespread on desert soil, though less so than *Zygophyllum album*, are:

*Lycium persicum* (a thorny shrub)

*Heliotropium tuberosum* (a dwarf shrub).

#### REPRESENTATION OF FAMILIES OF LEPIDOPTERA

The number of species in each family is as follows. The numbers in brackets indicate the place in the list of species:

Papilionidae	1 (No. 1)
Pieridae	3 (Nos. 2-4)
Lycaenidae	5 (Nos. 5-9)
Nymphalidae	2 (Nos. 10-11)
Danaidae	1 (No. 12)
Hesperiidae	1 (No. 13)
Lasiocampidae	1 (No. 14)
Sphingidae	4 (Nos. 15-18)
Arctiidae	2 (Nos. 19, 20)
Lymantriidae	1 (No. 21)
Noctuidae	51 (Nos. 22-72)
Geometridae	18 (Nos. 73-90)
Cossidae	3 (Nos. 91-93)
Total (excluding Pyralidae and Micros)	93

The Pyralidae and Microlepidoptera of Bahrain are being studied by Dr. H. G. Amsel and an account of them will appear later.



## ECOLOGICAL GROUPS OF SPECIES OF LEPIDOPTERA

The Lepidoptera can be classed ecologically as follows:

1. *Migrants*. These are liable to occur equally in desert or oasis, but they are commoner in the latter, and in Bahrain they can for the most part only breed there. They are liable to appear on the wing and disappear together, e.g. *V. cardui*.

2. *Oasis-dwellers*. These are never found in the desert and thus are stenoecous; they might be subdivided according to food-plant, e.g. *Z. knysna karsandra*.

3. *Desert-dwellers*. These are never found in oases; some are very localised, doubtless due to the localisation of their foodplant, e.g. *C. trochylus*.

4. *Non-migrants common to both desert and oasis*. A few such moths have been observed (e.g. *Porphyrinia bulla*); it seems likely that the foodplant is *Zygophyllum album* or some other plant found on both habitats; alternatively, they may be polyphagous and unusually adaptive.

## GEOGRAPHICAL ANALYSIS

An analysis of the ranges of Bahrain's Lepidoptera, correlated with their habitats, is now given. As in Wiltshire (1957), the species are attributed each to a geographical category according to their present distribution. In a very small number of cases attribution was doubtful, but as these would tend to cancel out if incorrect, the general picture will hardly be affected. First, a brief definition of the category is given, then the total number of species, and lastly the ecological distribution in Bahrain, each actual species being referred to in brackets by its number in the list.

I. *Asiatic-Tropical*. Old-World Tropical species absent from Tropical Africa, with headquarters in southern Asia: Total 12, of which 3 are Migrants (1, 2, & 10), 6 are Oasis-dwellers (9, 14, 21, 35, 56, 74), 2 are Desert-dwellers (69 & 82), while 2 are found on both biotopes (2 & 10).

II. *Palaeo-Tropical*. Species widespread in Tropical Asia and Africa. Total 23, of which 14 or 15 are Migrants (4, 5, 7, 12, (?) 13, 15, 16, 20, 22, 37, 38, 39, 45, 67, 85); 16 are Oasis-dwellers (4, 5, 6, 12, 13, 15, 16, 22, 37, 44, 51, 52, 55, 57, 64, 72); only one (7) is a Desert-dweller, but 6 occur on both biotopes (20, 38, 39, 45, 67, 85).

III. *Holo-Tropical* or *Almost World-wide*. Species occurring in both hemispheres (Old and New World), especially in the Tropics: Total, 5, of which 3 at least (11, 18, & 23) are Migrants. Three are,

in Bahrain, Oasis-dwellers (23, 36, & 53) while two (11 & 18) are found on both oasis and desert ground.

IV. *Eurooriental*. Species of a warm-temperate or even subtropical range, widespread between western Europe and the Indus Valley with headquarters north of the Tropic, particularly strong in the Middle East. Total 10, of which 3 or 4 are Migrants (3, 17, 54, & 86). Seven are oasis-dwellers in Bahrain (3, 17, 28, 34, 41, 42, 81) while the other three occur in both desert and oasis (54, 76, & 86).

V. *Euro-Siberian*. Wide-ranging cool-temperate species, distributed between western Europe and eastern Asia. Total 1, an Oasis-dweller (70).

VI. *Pan-Eremic*. Species ranging through the arid zone from Morocco to Jordan and thence to central Asia; the range thus crosses that of (IV) above, in the Middle East. Total 4, all Desert-dwellers (27, 65, 92, 93).

VII. *Eastern Eremic*. Species inhabiting the arid zone from the Nile to south Persia. Total 20, none being Migrants. Six are Oasis-dwellers (8, 29, 77, 80, 84, 89) while 12 are Desert-dwellers (26, 46, 47, 48, 50, 58, 63, 75, 78, 83, 90, 91); there are also two species occurring in both biotopes (19 & 79). In this category, moreover, it seems possible to distinguish two limited smaller sub-categories or ranges: (a) species found only in Bahrain and Eastern Arabia (47, 48, & 91), and (b) species found only in Bahrain and south Persia (29 & 78). It seems likely that further exploration of S. Arabia and S. Persia will show that these two categories are in fact one, and perhaps constitute a peculiar 'Arabian or Persian Gulf' sub-category in the Eastern Eremics, and that the one apparent Bahrain Endemic (see below) also belongs here.

VIII. *Saharan-Sindian*. Species inhabiting the arid zone from Morocco to south Persia or the Sind Desert. Total 17, none being Migrants. Five are Oasis-dwellers (31, 40, 59, 71, 73), while 11 are Desert-dwellers (24, 25, 30, 32, 43, 60, 61, 62, 66, 68, 87). There is also one species inhabiting both biotopes (49).

IX. *Endemic species*. (Only known from Bahrain): Total 1, an Oasis-dweller (33).

The total of Eremic species, 42, contains not one Migrant, in the accepted sense, though of course many desert-dwellers and oasis-dwellers in this super-category are blown many miles from habitat to habitat; but this does not occur with the rhythm of the Migrants.

I shall not attempt again here to suggest centres of origin for these range-categories, as I have done this in Wiltshire (1957), and have also given my views on such theories in Wiltshire (1962).

The Migrants totalling 24 species are all either Tropical Euroriental or Almost World-wide species. Although not all have been recorded from both biotopes in Bahrain one can safely predict that all will eventually be found in both oasis and desert, though the former, as has been said, is their main breeding ground in Bahrain. In other parts of the desert and steppe zone, however, the desert may for a short season provide copious food for some of these. The extremely low rainfall figure of Bahrain is doubtless the reason why this is not the case here.

The Oasis-dwellers' total is 45, the Desert-dwellers' total 29. The total found on both biotopes is 19. Grand Total: 93.

#### ZOOGEOGRAPHICAL SUMMARY AND DISCUSSION

Summarising these figures, one notes that one quarter of the whole Lepidopterous fauna is Migratory; that the Tropical component outnumbers the Temperate and Eremic in oases, while in the desert the Eremic predominates. The total absence of an African Tropical element contrasts notably with the strength of this component along the coast of southern Arabia. This confirms the dividing line between the two Tropical Regions suggested in Wiltshire (1952), i.e. a line running roughly from near Masira Island north-westwards to the heart of the Syrian Desert, leaving the Persian Gulf as completely Asiatic, in so far as the Tropical fauna is concerned. The true frontier, or natural barrier between the Ethiopian and Indian Regions, is thus desertic; the two epicontinental seas, the Red Sea and the Persian Gulf, are insignificant barriers.

Of the Eremic categories, the Pan-Eremic (the most northerly) is weakly represented, while the other two, the Eastern Eremic and Saharan-Sindian, are about equally strong.

The Bahrain fauna is thus a very mixed one. Its poverty is clear from the brevity of the list, with less than a hundred 'Macro-Lepidoptera', and no more than twelve or thirteen butterflies. Islands are, of course, nearly always poor in comparison with the adjacent mainland, but the poverty of Bahrain's fauna is less due to its isolation than the climate, which it shares with the nearest continental shores. For according to Marsh (1960) the number of butterfly species inhabiting Hong Kong, an island in much the same latitude but off the eastern coast of Asia with adequate rainfall for forest or un-irrigated cultivation, is 184 species, i.e. Hong Kong is 14 times richer.

Of Bahrain's 13 species, 6 actually also occur in Hong Kong (1, 5, 9, 10, 11, & 12).

The desert is the main stronghold of the really characteristic species of Bahrain, while the oasis, though richer in species, contains fewer such.

Ignoring, however, the characteristic Eremic species in the desert, we may alternatively conceive of the whole region with its small patches of oasis and its vast steppes, dunes, and stony desert, as a battlefield between the neighbouring faunas, the invaders' enemy being not the natives but the climate. If in time this should improve, more species of the surrounding regions will be able to effect a settlement; while if aridity increases further, the number of the invading species at first, and later even that of the natives, will be reduced. Taking an even longer view, we can add that the natives, or Eremic species, whether derived from Tropical or Temperate stocks, are those that have won the battle by age-long specialisation and evolution. An analysis of Bahrain's interesting fauna points to these conclusions.

#### NOTE ON THE COLLECTIONS AND ON PREVIOUS PUBLICATIONS

The list of Lepidoptera species which now follows is based on two collections made in 1959-1962:

(i) that of L/Aircraftsman D. Rush (1959-60), since presented to the British Museum,

(ii) that of E. P. Wiltshire (1959-62).

Descriptions of new species and forms from Bahrain found in these collections, together with other taxonomic notes, and illustrated by two half-tone plates and twenty black and white figures appeared in an article by the present author: 'A new genus, eight new species, seven new forms, and notes on the Lepidoptera of Saudi Arabia, Bahrain, and Iran' (*J. Bombay nat. Hist. Soc.* **58** (3) : 608-631, December 1961).

Biological notes with illustrations of larvae etc. from Bahrain (and also taxonomic notes on one species, namely *Thiacidas postica* Walker) appeared in an article by the present author entitled 'Early stages of Old World Lepidoptera, XII' [*ibid.* **59** (3) : 778-799, 4 Plates, December 1962].

The above two papers were the first two publications to deal with the Lepidoptera of Bahrain and the present paper should be studied in conjunction with them.

## ANNOTATED LIST OF SPECIES

## Explanation of abbreviations:

AT	Asiatic-Tropical	M	Migrant
D	Desert-dweller	O	Oasis-dweller
EE	Eastern Eremic	PE	Pan-Eremic
EN	Endemic	PT	Palaeo-Tropical
EO	Euroriental	R	Resident
ES	Euro-Siberian	SS	Saharan-Sindian

WW (Almost) World-Wide

See above for the definition of these terms.

The roman numbers i-xii refer to the calendar months.

## Family PAPILIONIDAE

1. *Papilio demoleus* L.

O. Larvae of various sizes have been noted on *Citrus* in xii & vii. The imago has been seen flying in iv, v, vi, & viii. Any garden with oranges or limes may be a breeding ground, but the main centre is the oasis strip in the north-west. R. & M. AT.

## Family PIERIDAE

2. *Colotis fausta* Oliv.

O. Seen flying in the north, in the oasis zone, in xi-61 and v-62. M. AT.

3. *Colias croceus* Fourc.

O. Several examples were taken at Budeia Farm about 31-iii-62, but it has not been seen at all otherwise. M. EO.

4. *Catopsilia florella* F.

O. One or two were taken about 31-iii-62 at Budeia Farm, but otherwise it has not been noticed. M. PT.

## Family LYCAENIDAE

5. *Cosmolyce baeticus* L.

O. Noted on the wing in iii, v, vi, xi, and xii. Probably might be taken in any month, as it was not watched for. M. & R. PT.

6. *Tarucus rosaceus* Aust. (identity confirmed from ♂ genitalia)

O. A nearly full-grown larva attended by an ant was found on *Zizyphus spina-christi* on 2-xii-60. Imagines were seen flying in iii, iv, v, xi, & xii. R. PT.

7. *Freyeria trochylus* Courv.

D. Very local, only taken once and in one place, viz. Jebel Dokhan, rocky desert at c. 350 feet, certain water-courses, 9-xii-60. R. PT.

8. *Chilades galba* Led.

O. Not uncommon in oases, particularly gardens overgrown with its foodplant, *Prosopis stephaniana*, but sometimes also flying in singletons to flowers in gardens where this is not the case. Has been noted in v, but doubtless might be taken in some other months. R. EE.

9. *Zizeeria knysna* Trim. subsp. *karsandra* Moore

O. Common in oases, swarms in lucerne (or Alfalfa, Arab. *jett.*) fields in v, but also seen in most other months. R. AT (PT. if African subspecies is counted).

## Family NYMPHALIDAE

10. *Junonia orithya* L. subsp. *cheesmani* Riley

A migrant, commonest in, and breeding in, oases, but also occasionally seen in the desert, e.g. Jebel Dokhan 26-xii-61. Has been noted in all months except vii, viii, & ix. Foodplant: *Lippia nodiflora* (see Wiltshire 1962a). AT.

11. *Vanessa cardui* L.

A migrant, not yet observed as breeding in Bahrain despite search for larvae, a winter visitor seen both in desert and oasis, seldom in numbers, but fairly regularly between x and iii. WW.

## Family DANAIIDAE

12. *Danaus chrysippus* L.

This migrant appears commonly and then disappears again. The only foodplant on the island is *Asclepias curassavica*, a rather infrequent garden flower. Observed in oases in ix-xii and again in iv & v. PT.

## Family HESPERIIDAE

13. *Pelopidas thrax* Hübn. ssp. *midea* Walker

The only record is at Budeia Farm, 3-iv-62, an oasis locality. Until this locality has been more carefully studied all the year round, it would be premature to conclude that the specimens seen were no more than visiting migrants. O. PT.

## Family LASIOCAMPIDAE

14. *Nadiasa siva* Lef.

R. Principally in oasis, on *Casuarina* (first record of any lepidoptera on this tree in Middle East!), *Zizyphus spina-christi* (Arab. *Nebk, Sadr*), Apricot (*Prunus armeniaca*, Arab. *Mish-mish*), *Prosopis stephaniana* (Arab. *Shok*), also, one larva only thriving on Oleander (*Nerium oleander*) (on which hitherto no larva other than that of *Daphnis nerii* has been noticed, owing, supposedly, to its poisonous properties). It is also seen occasionally breeding in the desert on *Acacia* stands (but these are very local; and it seems to disappear from these places in some years). The moth flies mainly in i-iii, the larva is most often seen in the autumn. AT.

## Family SPHINGIDAE

15. *Herse convolvuli* L.

The larva of this migrant has been noted in oases in v-vi. The foodplant grows in grassy places quite commonly and is a small *Convolvulus* sp. The adult occasionally comes to light in oases. Young larvae noted, 28-v-59. Imagines, 31-x-61. PT.

16. *Daphnis nerii* L.

The early stages and adult of this migrant are only seen in oases, and in the cooler months. Foodplant, *Nerium*, said to have been only recently introduced into Bahrain. Larvae noted mainly in xi, emergence of adult in i. PT.

17. *Macroglossa stellatarum* L.

The foodplant of this migrant does not grow on the island and it is a mere winter visitor. It has been seen in gardens on 2-xi-62 & 15-ii-62. EO.

18. *Celerio lineata* F. subsp. *livornica* Esp.

This migrant has occasionally been attracted to light in oases. Its larva has never been observed on the island. WW.

## Family ARCTIIDAE

19. *Nola harouni* Wilts. subsp. *dilmuna* Wiltshire, 1961

R. Mainly in oases. For details of early stages see Wiltshire 1962. The adult has been taken to light, or bred from larvae feeding on Papilionaceae, between xii and v. EE.

20. *Utetheisa pulchella* L.

This migrant is seen commonly on the wing in oases in most months except vii, viii, & xii; the larva has not been found, though looked for, on both species of Heliotrope, i.e. the desert-growing species *tuberculatus*, and a more lush species found on oasis ground. It has once been seen on the wing in the desert, namely on 19-xi-59 at Jebel Dokhan. PT.

## Family LYMANTRIIDAE

21. *Euproctis cervina* Mre. (Plate III, figs. 7-8)

R. O. Flies in repeated broods between April and October; localised in gardens near the Adari Pool. Foodplants: *Terminalia catappa* (Indian almond) and *Alhagi maurorum* (Camel-thorn). For taxonomic details see Wiltshire 1961, and biological details Wiltshire 1962a. AT(?).

## Family NOCTUIDAE

22. *Scotia spinifera* Hübn.

Probably a migrant. Taken by D. Rush in x, 1959. PT.

23. *Scotia ipsilon* Hufn.

O.M. Seen occasionally, e.g. 18-xi-59, Manama Gardens. WW.

24. *Scotia herzogi* Rebel subsp. *saracenic*a Tams

Found in similar places with the following species, but less common there. A univoltine moth appearing any time between xi & iii generally, but only taken in Bahrain on 4-iii-62. SS. R.

25. *Scotia sardzeana* Brandt

Resident in grassy, sandy patches of deserts; local in Bahrain, only in the southern desert, but common at the right season to light. Univoltine, taken on 5-xi-61, 17-xi-60, and 21.xi-62. SS.

26. *Scotia margelanoides* Boursin (Plate III, fig. 2)

One specimen only has been taken, to light at Muharraq, by Rush in xi, 59 (Prep. Wiltshire 1031), and may have been a vagrant from the mainland. EE. Other known habitats: Palestine and Arabia.

27. *Scotia lasserrei* Ob.

Common locally in the southern desert; univoltine, flying in xi. R. PE.



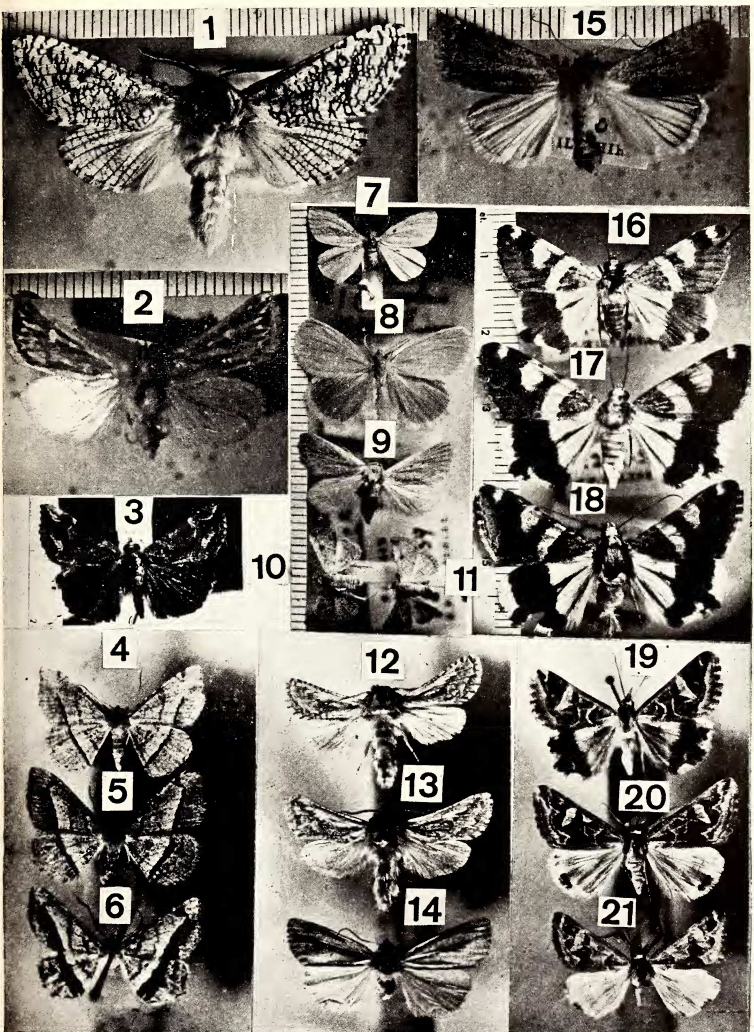


Fig. 1. *Lamellocossus chesmani* Tams (91); 2. *Scythia marginaloides* Boursin (26); 3. *Hypena abyssinialis* Guenee (72); 4, 5, 6. *Semiothisa syriacaria* Staudinger (89); 7. *Euproctis cervina* Moore, gen. 3. male (21); 8. *Euproctis cervina* Moore, gen. 1 (21); 9. *Porphyria bulla* Swinhoe (49); 10, 11. *Autoba gayneri* Rothschild (51); 12, 13. *Dyspessa vulgeri* subsp. *jordanii* Staudinger (93); 14. *Mythimra brandti* Boursin (29); 15. *Caradrina ingrata* Staudinger (49); 16, 17, 18. *Drasteria yerburyi* Butler (63); 19, 20. *Cerocala sana* Staudinger, female; (53); 21. *Cerocala sana* Staudinger, male (58).



28. *Cardepija sociabilis* Grasl. subsp. *albipicta* Christ.

A halophile species, twice taken by Rush near the Adari Pool in xi. R. O. EO.

29. *Mythimna brandti* Boursin (Plate III, fig. 14)

Described in 1963 in *Arkiv. för Zoologi* 16 (8), Stockholm, this species was recorded by Brandt erroneously under the name '*Sideridis prominens* Walker' from south Persia. In Bahrain it is very local, one specimen having been taken flying over reeds and grass on the banks of the Adari streams, 8-iii-61. R.O. EE.

30. *Cleophana chabordis* Ob.

R.D. Flies in the southern desert in iii & iv. SS.

31. *Catamecia minima* Swinhoe

R.O. Taken near the Adari Pool in iii & v. SS.

32. *Scythocentropus inquinatus* Mab.

R.D. A univoltine moth, flying in x. Only one specimen has been taken in Bahrain, namely at Sakhir, 29-x-59. SS.

33. *Cryphia polyphaenoides* Wiltshire, 1961

The unique type, a ♀, taken on 23-ii-60 at the Adari Pool, remains the only known example of this species. R.O. EN.

34. *Hadjina viscosa* Freyer subsp. *persicola* Strand

Owing to localisation of its foodplant *Pluchea dioscoridis* in the Adari garden area, this moth is equally local. Both the adult and larvae were found near foodplant bushes on 27-iii-60 and the larva produced an adult on 17-iv. It is in fact a multivoltine species. R.O. EO.

35. *Perigea illecta* Walker

For the biology, see Wiltshire 1952. The foodplant and habits are similar to those of the preceding species. A male, taken on 22-i-60, Prep. Wiltshire 1047, and a further example bred from a larva, 19-iii-60. R.O. AT.

36. *Prodenia litura* F.

Probably a migrant, certainly a pest to agriculture, this moth was particularly numerous on the wing throughout iii-61 in the Adari gardens, but has also been seen in iv, v, and ix, always in oases. The larvae have been seen on lettuce in xii, and doubtless feed on various garden flowers and plants. WW.

37. *Spodoptera cilium* Gn. subsp. *latebrosa* Led.

Probably a migrant, common in gardens, but less so than the following species. Both feed on lawn grass. It is multivoltine and has been noted in iii, v, vii, ix, x, xi, & xii to light. O. PT.

38. *Spodoptera mauritia* Boisd.

Though commoner than the preceding in Bahrain, this species reaches less far north, and indeed in the Persian Gulf area is here at its northern limit. See Wiltshire 1962a for observations of its larva on lawn grass, and comparison of larva with that of *cilium*. It has been noted on the wing in ii, iii, iv, v, vii, ix, x, xi, & xii in Bahrain. The capture of one example (17-ii-60) in the desert is probably evidence that it is a migrant. All other records were in gardens. Multivoltine. PT.

39. *Layhygma exigua* Hübn.

This well-known pest and migrant, to judge from the dates of capture in Bahrain, is here more of a visitor and less of a breeding resident than the two preceding species, and indeed its larva has not yet been noted on the island. For its general biology and status in the Middle East adjacent to Bahrain see Wiltshire 1957. The moth has been taken to light occasionally in the desert but mostly in oases in iii-v, vii, & ix. PT.

40. *Caradrina ingrata* Stgr. (Text-fig.; Plate III, fig. 15)

An oasis moth, only taken in Bahrain at the Adari Pool, in iii. Its foodplant here is unknown, *Salix* (on which it was found in Basra, S. Iraq) being absent. Elsewhere in its range it appears to be at least bivoltine. Its range is Saharan-Sindian, and its male genitalia become increasingly asymmetrical towards the east. At present Bahrain is its easternmost known habitat, and ventral process of the right valve of Bahrain males is spatulate, while that of the left one tapers. In N. Africa both are alike, tapering; in Palestine some individuals tend slightly to a broadening of the right-hand process, and in S. Iraq the broadening approaches that remarked in Bahrain (see Text-fig., Prep. 1068). The female genitalia show no such cline.

41. *Heliothis nubigera* H.-S.

M. Occasionally to light in desert or oasis in the cooler months, e.g. i, x, xi. EO.

42. *Heliothis peltigera* Schiff.

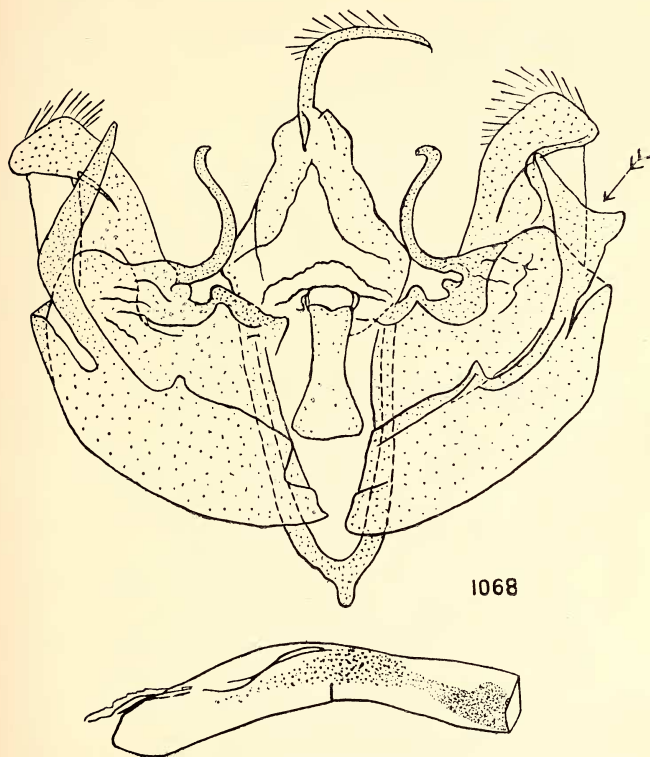
M. Once seen at light, Manama Gardens, 2-iii-60. EO.

43. *Timora albida* Hamps.

Rare, in the southern desert, 24-iii-62. SS.

44. *Porphyrinia cochylioides* Gn.

Once taken in Manama Gardens, 28-v-59. R(?). O. PT.



1068

Text-fig. *Caradrina ingrata* Stgr. Male genitalia (Bahrain form). An arrow indicates the asymmetrically-formed right valve process.

45. *Porphyrinia parva* Hübn.

Has only been taken in the desert, in ii, x, & xi. R(?). PT.

46. *Porphyrinia pallidula* H.-S. subsp. *khalifa* Wiltshire, 1961

Fairly common in the desert in i, ii, ix, & xii. R. EE.

47. *Porphyrinia rushi* Wiltshire, 1961

Mainly in the southern desert, ii-iv. R.D. EE.

48. *Porphyrinia bistellata* Wiltshire, 1961

In the southern desert, mainly in iii-iv but occasionally also in x. R.D. EE.

49. *Porphyrinia bulla* Swinhoe (= *tomentalis* Rebel) (Plate III, fig. 9)

R. Very common in the desert in i-iv & x. Occasionally on oasis ground. SS.

50. *Porphyrinia straminea* Stgr. (?)

R.D. A single ♀ taken in the desert on 19-xi-59, was thought to be this species but, as no ♂ was taken and no further certain examples taken, its identification remains doubtful, likewise the claim of the species to be on the Bahrain list. The genitalia resemble the female genitalia of the preceding species, particularly the bursa-spiculation, but are comparatively larger, the posterior apophyses seeming also proportionately longer. EE.

51. *Autoba gayneri* Roths. (Plate III, figs. 10-11)

R.O. 18-xi-59, 9-i-60, 2-i-62. PT.

52. *Earias insulana* Boisd.

Occasionally taken to light in gardens in ii & iii. R.O. PT.

53. *Characoma nilotica* Rog.

Occasionally to light in ii in gardens. R.O. WW.

54. *Trichoplusia ni* Hübn.

This migrant occurs both in desert and oasis, doubtless breeding more in the latter. Taken to light in i, iii, & ix, adults have also been raised in iv from ova laid by a ♀ taken in iii. EO.

55. *Plusia daubei* Boisd.

As its foodplant elsewhere is reported to be *Pluchea* and this is found in Bahrain gardens, it may well be resident. However it is rare, only one example having been taken, 16-iii-61, Adari Pool. PT.

56. *Thiacidas postica* Walker [= *Raphia (Tiessa) cheituna* Brandt]

See Wiltshire 1962a for biological and taxonomic notes on this species. The foodplant is *Zizyphus spina-christi* (Arab. *Nebk*, *Sadr*; Christ-thorn). Bivoltine, flying in spring and autumn. The

autumnal larvae often defoliate whole branches of the tree. Many of them spend ten months in a pre-pupal coma in the cocoon instead of appearing in the spring on the wing. R.O. AT.

57. **Dysgonia torrida** Gn. (= *albivitta* Gn.)

This moth appeared in large numbers in the Adari gardens to *Prosopis spicigera* catkins in iii-60 but was otherwise not seen. R.O. PT.

58. **Cerocala sana** Stgr. (Plate III, figs. 19-21)

See Wiltshire 1962a for biological notes. It flies in the southern desert between late x and early iii. Foodplant, two species of *Helianthemum*. R.D. EE.

59. **Hypoglaucitis benenotata** Warren

Only one female has been taken, 26-ii-60, in Manama Gardens. It is surprising that it is not commoner, as the foodplant (*Tamarix articulata*, Arab. *Ithl*) is planted in several gardens. R (?). O. SS.

60. **Cortyia vetusta** Walker

Comes to light occasionally in the desert during the cooler months, xii-iv. R (?). D. SS.

61. **Cortyia acrosticta** Pung. (= *rosacea* Rebel)

Known to feed elsewhere on *Acacia*, this desert moth has once been taken, on 28-iv-62, in the desert. R (?). D. SS.

62. **Gnamptonyx vilis** Walker

Also known to feed on *Acacia* elsewhere, this moth has similarly been taken in two examples only in the southern desert on 28-iv-62. R (?). D. SS.

63. **Drasteria yerburyi** Butler (= *pica* Brandt) (Plate III, figs. 16-18)

See Wiltshire 1962a for biological and other notes on this species. Foodplant: *Taverniera spartea*. In those parts of the desert where this grows it flies during the cooler months ix-iv, and the larva may be found at night on the plant during the same season. R.D. EE.

64. **Mocis frugalis** F. subsp. *nigripunctata* Warren

Flies in the grassier gardens between xi and iv, both by day and to light. See Wiltshire 1962a for biological notes; the foodplant is grass. R.O. PT.